



## **Nanobits, Membranes and Micro Four-Point Probes: Customizable Tools for insitu Manipulation and Characterisation of Nanostructures**

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**Nanobits, Membranes and Micro Four-Point Probes: Customizable Tools for insitu Manipulation and Characterisation of Nanostructures** PETER BOGGILD, DIRCH HJORTH PETERSEN, OZLEM SARDAN SUKAS, HENRIK FRIIS DAM, ANDERS LEI, TIMOTHY BOOTH, KRISTIAN MOLHAVE, DTU Nanotech - Technical University of Denmark, VOLKMAR EICCHORN, University of Oldenburg — We present a range of highly adaptable microtools for direct interaction with nanoscale structures; (i) semiautomatic pick-and-place assembly of multiwalled carbon nanotubes onto cantilevers for high-aspect ratio scanning probe microscopy, using electrothermal microgrippers inside a SEM. Topology optimisation was used to calculate the optimal gripper shape defined by the boundary conditions, resulting in 10-100 times better performance. By instead pre-defining detachable tips using electron beam lithography, free-form scanning probe tips (Nanobits) can be mounted in virtually any position on a cantilever; (ii) scanning micro four point probes allow fast, non- destructive mapping of local electrical properties (sheet resistance and Hall mobility) and hysteresis effects of graphene sheets; (iii) sub 100 nm freestanding devices with wires, heaters, actuators, sensors, resonators and probes were defined in a 100 nm thin membrane with focused ion beam milling. By patterning generic membrane templates (Membranes) the fabrication time of a TEM compatible NEMS device is effectively reduced to less around 20 minutes.

☒ Prefer Oral Session  
☐ Prefer Poster Session

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